



Threats to civilian aviation since 1975

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Question

- *What are the major threats and risks to civilian aviation?*
- *What are the factors that increase / decrease these risks and threats?*

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1. Summary

This literature review finds that the main malicious threats to civilian aviation since 1975 are attacks by terrorist groups, deliberate or accidental damage arising from conflicts and incidents caused by people who work for airlines or airports. While the sector has responded to hijackings and bombings with increasing security since the 1970s, actors seeking to attack aircraft have modified their tactics, and new threats such as liquid explosives and cyber attacks have emerged. Civilian aviation has seen relatively fewer accidents and deaths over the years, but threats remain.

The review focuses on malicious threats to civilian aviation. It therefore excludes weather events or accidents.¹ **The first section lists major malicious threats to civilian aviation since 1975.** It includes both actual and planned events (e.g. hijackings that were prevented) that are recorded in open-source documents. Each threat is listed alongside information on its cause (e.g. terrorism, state actions, crime), the context in which it occurred (broader factors shaping the risk including geography, regime type, technology) and its impact (on passengers, policy, security, economic).

The second section discusses some of the trends in threats to aviation. Motives for malicious threats include terrorism, crime, asylum seeking and insider attacks by aggrieved or mentally ill airline staff. Hijacking has been the most common form of threat, although bombing or suicide attacks have killed more people. Threats may also take the form of accidental attacks on civilian planes misidentified as threats in conflict zones. Experts suggest that growing threats are cyber attacks and the use of unmanned aerial vehicles, although neither has yet caused a major incident.

The civilian aviation sector has seen increased security over the years, from passenger and baggage checks to x-ray and metal detecting scans, and guards on board, often in response to incidents. Strategies for dealing with threats to aviation centre on security measures at airports, in passenger screening, and on aeroplanes. They also include decisions on how to respond to threats, such as whether to negotiate and what measures to use in hostage situations, for example. Strategies in place to address the risk from rogue airline or airport staff include better psychometric screening and flight procedures (e.g. the number of pilots in cabin); and better job security to reduce stress and the attractiveness of bribes.

The number of incidents in the sector overall, relative to the number of flights, has decreased.² However, incidents such as a terrorist attack, a stray missile or a disaffected crew member, remain significant threats. In addition, several authors point to airlines' and airport operators' vested interest in keeping passenger numbers high which can lead to delays in implementing security measures that delay flights.

The visibility of air travel makes it appealing to hijackers or bombers. Destroying or taking control of an aeroplane can give a group or individual significant leverage, as well as high levels of publicity. Aims vary significantly, but can include asking for ransoms, the release of political

¹ Sabotage only accounts for around 10% of aviation disasters, with pilot error, mechanical failures and weather much greater risks. <https://theconversation.com/the-five-most-common-reasons-for-airliner-disasters-50100>

² see section 2 and appendix

prisoners, the opportunity to create a spectacle, seeking asylum, the airing of grievances, or killing particular people/groups. Aircraft are also vulnerable to accidental shooting down by armed groups or state armies. They may be used by pilots or crew members, who can bypass many security measures, to commit suicide or make an insurance claim.

Different forms of attack are more prevalent in different times and places, shaped by geopolitical conditions and security measures. For instance, hijacking was driven by decolonisation struggles and the Cold War in the 1960s and 1970s. It was dramatically reduced within the United States by increased security measures in the 1970s, but US-flagged airlines operating elsewhere remained vulnerable to hijackings. Groups or individuals who aim to use planes and airline passengers as leverage, accounting for most hijackings until the 2000s, present a different threat to groups who aim to maximise damage and therefore cannot be negotiated with. The threat of missile attacks is much greater in conflict zones or areas where non-state armed groups operate independently of effective command structures. In it unclear how capable airlines and airports are to deal with threats from cyber-attacks and unmanned aerial vehicle (UAVs).

2. Incidents

The first hijacking happened in 1931 when revolutionaries in Peru coerced an aeroplane owner to carry them. The first airline bombing occurred in 1933 on a United Airlines flight from Cleveland to Chicago and killed 7 people (Price and Forrest, 2016, p. 51). However, attacks on civilian aviation are seen to have become a significant problem by the 1960s when terrorist groups adopted hijacking and bombing to further their ends.

Malicious incidents can be defined and categorised in a number of ways. This review includes all malicious³ activity disrupting civilian aviation in some way. It includes acts motivated by political, monetary, other, or unknown reasons. Types of incident include hijackings, bombings, suicide bombings, deliberate crashes, missile attacks, gun or knife attacks, cyber attacks and attacks by unmanned aerial vehicle (UAVs). It also includes apparently accidental attacks, such as the shooting down of planes misidentified as threats by militaries or non-state armed groups.

The list of incidents has been derived from a number of open-access sources, including the aviation safety online database, academic articles and news sources. The list is not comprehensive, and incidents are selected for their significance, understood as death toll, media attention, and effect on aviation security regimes or international relations. It omits a large number of hijackings, attempted hijackings, bombings, missile attacks and other incidents. The next section of the report discusses the trends in threats to civilian aviation and outlines emerging threats.

Figure 1: non-comprehensive list of malicious incidents featuring civilian aviation since 1975.

³ While most of the incidents discussed are crimes, their precise status varies from state to state and over time as new anti-hijacking or anti-terrorism laws have been implemented. The popular understandings of many hijackings also varies significantly, particularly hijackings connected to national liberation movements such as Palestine's.

Date	Incident	Cause	Context	Impact
1975	Malév flight MA240 ⁴	Unknown	Possibly related to disputes over Palestine ⁵	60 killed
1976	Philippine Airlines 116 hijacked ⁶	Six hijackers took over the plane and demanded money and a flight to Libya. After landing to refuel, they were overwhelmed by security forces and passengers were killed in the fight.	Islamic separatist movement. ⁷	13 killed
1976	Air France flight 139 hijacked ⁸	Members of the Baader-Meinhof gang hijacked a plane and took it to Entebbe, Uganda. They released all except the 105 Israeli and Jewish passengers, and demanded Israel release 53 Palestinian prisoners. The hijackers were overcome by Israeli commandos.	Left-wing terrorism. Israel-Palestine conflict.	3 hostages and killed. Increased security at Israeli airports and airlines. Hardened no-negotiation stance.
1976	Cubana de Aviación 455 bombed ⁹	Venezuela blames US-backed Cubans ¹⁰	Disputes between the US and communist Cuba	73 killed
1976	Middle East Airlines 438 exploded over the Saudi Arabian	Bomb in the baggage hold.	Bombers not identified by possibly related to	81 killed

⁴ <https://aviation-safety.net/database/record.php?id=19750930-1>

⁵ <https://aeronauticsonline.com/still-no-hope-in-the-most-mysterious-crash/>

⁶ <https://aviation-safety.net/database/record.php?id=19760523-1>

⁷ <https://www.nytimes.com/1976/05/24/archives/3-hijackers-and-10-hostages-die-as-philippine-plane-is-set-on-fire.html>

⁸ <https://aviation-safety.net/database/record.php?id=19760627-1>

⁹ <https://aviation-safety.net/database/record.php?id=19761006-0>

¹⁰ <http://news.bbc.co.uk/1/hi/world/americas/4289136.stm>

desert ¹¹		conflict in Oman ¹²		
1977	Malaysian Airlines System flight 653 hijacked and crashed ¹³	Hijackers demanded to be flown to Singapore, then shot pilots and themselves.	Hijackers have never been identified ¹⁴	100 killed
1977	Lufthansa flight 181 hijacked	Popular Front for the Liberation of Palestine members demanded released of Red Army Faction prisoners and USD 15 million. The plane eventually landed in Mogadishu where it was stormed by West German and Somali commandos.	Israel-Palestinian conflict. RAF campaign.	4 killed. West Germany's non-negotiation stance developed after previous hijackings reaffirmed. Improved flight links between West Germany and Somalia.
1977	Japan Air Lines flight 472 hijacked ¹⁵	Five armed Japanese Red Army (JRA) members demanded the release of political prisoners and USD 6 million. The Japanese government acquiesced and all the hostages were released	Left wing terrorism	0 killed Establishment of a Special Assault Team within the Japanese police to deal with hijackings.
1978	Shooting down of Korean Air Lines Flight 902 ¹⁶	Navigation errors. Was shot down by Soviet fighter jets after entering Soviet airspace.	Cold War	2 passengers died.
1978	Air Rhodesia Flight 825 ¹⁷	Shot down with a Strela 2 surface-to-air missile by the Zimbabwe People's Revolutionary Army.	Conflict between colonial and anti-colonial forces.	38 passengers died in the crash and 10 were killed by guerrillas after the crash. Increased racial

¹¹ <https://aviation-safety.net/database/record.php?id=19760101-1>

¹² <https://news.google.com/newspapers?id=ur0yAAAAIBAJ&sjid=qe0FAAAAIBAJ&pg=4271%2C4951988>

¹³ <https://aviation-safety.net/database/record.php?id=19771204-0>

¹⁴ https://edition.cnn.com/2014/03/27/world/asia/malaysia-mh653-crash-relatives/index.html?hpt=hp_c1

¹⁵ <https://aviation-safety.net/database/record.php?id=19770928-0>

¹⁶ <https://aviation-safety.net/database/record.php?id=19780420-1>

¹⁷ <https://aviation-safety.net/database/record.php?id=19780903-1>

				tensions and vigilante violence in Zimbabwe and breakdown of peace talks.
1979	Air Rhodesia Flight 827 ¹⁸	Shot down with a Strela 2 surface-to-air missile by the Zimbabwe People's Revolutionary Army.	Conflict between colonial and anti-colonial forces. Attempt to assassinate military figure.	59 killed. Escalation of conflict. Low radiation paint to shroud exhaust fumes and make planes less visible
1979	United Airlines flight 444 bombed ¹⁹	A bomb with a barometric trigger exploded in the baggage hold, but the plane was landed safely	Traced to Ted Kaczynski, the 'Unabomber', a lone terrorist	0 killed
1980	Explosion on Itavia Flight 870 from Bologna to Palermo ²⁰	Unknown. Perhaps accidental fire from a NATO exercise, or a bomb on the plane.		81 killed
1980	Crash of Linhas Aéreas de Angola Yakovlev Yak-40 ²¹	Possibly shot down	Angolan civil war	13 killed
1982	Pan Am Flight 830 was bombed between Tokyo and Hawaii ²²	Is alleged to have been placed by Mohammed Rashed, a Jordanian connected to the 15 May Organization, a small Palestinian liberation group.	Israel-Palestine conflict.	1 killed
1982	Japan Airlines flight 350	Pilot deliberately crashed the plane	Mental health and job insecurity (Nori, 2020, p. 63)	24 killed
1983	Korean Air Lines Flight 007 ²³	Navigation errors. Was shot down by Soviet	Cold War	269 killed. Increased Cold War

¹⁸ <https://aviation-safety.net/database/record.php?id=19790212-1>

¹⁹ <https://aviation-safety.net/database/record.php?id=19791115-1>

²⁰ <https://aviation-safety.net/database/record.php?id=19800627-0>

²¹ <https://aviation-safety.net/database/record.php?id=19800608-0>

²² <https://aviation-safety.net/database/record.php?id=19820811-0>

²³ <https://aviation-safety.net/database/record.php?id=19830901-0>

		fighter jets after entering Soviet airspace.		<p>tensions</p> <p>US legislation to increase compensation victims' families could get, and lower the burden of proof ²⁴</p> <p>Encouraged US leaders to allow GPS to be used by civilians (Pace et al., 1995, p. 42).</p>
1983	Gulf Air Flight 771 ²⁵	The crash was caused by a bomb in the cargo hold.	Possibly planted by the Abu Nidal Palestinian terrorist organisation.	112 killed
1985	Polar 3 shot down in Western Sahara, Morocco ²⁶	Missile	War between Morocco and West Sahara separatists.	3 killed
1985	Bakhtar Afghan Airlines Antonov An-26 shot down ²⁷	Ground-to-air missile	War in Afghanistan ²⁸	52 dead
1985	Hijacking of TWA Flight 847	<p>Lebanese citizens hijacked plane in Athens. They demanded to go to Algiers and that political prisoners in Israel were released. It refueled in Beirut, flew to Algiers where it was refused permission to land, before returning to Beirut where hostages were kept. One hostage was killed and others were released after negotiation.</p>	Lebanese politics. Israel-Palestine conflict.	<p>1 killed</p> <p>Authorities learned several lessons (Price & Forrest, 2016, p. 67):</p> <ul style="list-style-type: none"> -to keep hijacked aircraft on the ground (when the hijackers attempted to land at Beirut, they were initially not given permission as hijacked aircraft were not classified as 'in distress', which would have allowed them to land and be helped). -to train flight crews

²⁴ <https://www.nytimes.com/1997/03/31/nyregion/grieving-father-s-14-year-crusade-helps-air-crash-victims.html?auth=login-google>

²⁵ gulf air 8

²⁶ <https://aviation-safety.net/database/record.php?id=19850224-0>

²⁷ <https://aviation-safety.net/database/record.php?id=19850904-0>

²⁸ <https://www.nytimes.com/1985/09/09/world/afghan-rebels-deny-kabul-report-that-they-downed-civil-airlines.html>

				in emergency safety and crisis management.
1985	Air India 181/182 ²⁹	A bomb exploded on a flight between Montreal and London. It may be linked with an explosion the same day at Tokyo-Narita airport.	Possibly extremist Sikh group Babbar Khalsa ³⁰ (Price and Forrest, 2016 p. 68)	329 killed A five step screening process (including x-ray, visual, explosives) was instituted in Canada (Price & Forrest, 2016, p. 69) A Canadian government enquiry was finished in 2010 and concluded, among other things, that security flaws remained, particularly in respect to cargo ³¹
1985	Egypt Air 648 hijacked and 61 killed from shooting by the hijackers and when Egyptian forces stormed the plane in Malta ³²	Members of the Abu Nidal organisation	Israel-Palestine conflict.	61 killed Criticism of the Maltese response and the Egyptian operation ³³
1985	Rome Airport attacked by men with guns and grenades	Members of the Abu Nidal Organisation (ANO) (Duchesneau & Langlois, 2017, p. 347)	Israel-Palestine conflict	16 passengers and 3 gunmen killed
1985	Vienna Airport attack with grenades	Members of the Abu Nidal Organisation (ANO)	Israel-Palestine conflict	3 passengers killed
1986	TWA Flight 840 ³⁴	A bomb exploded on a flight between Rome and Athens	A member of the Abu Nidal extremist group was suspected but no one has been	4 killed

²⁹ <https://aviation-safety.net/database/record.php?id=19850623-2>

³⁰ <http://news.bbc.co.uk/1/hi/world/americas/4344051.stm>

³¹ https://epe.lac-bac.gc.ca/100/206/301/pco-bcp/commissions/air_india/2010-07-23/www.majorcomm.ca/en/reports/finalreport/key-findings.pdf

³² <https://aviation-safety.net/database/record.php?id=19851124-0>

³³ http://news.bbc.co.uk/onthisday/hi/dates/stories/november/24/newsid_4356000/4356024.stm

³⁴ <https://aviation-safety.net/database/record.php?id=19860402-1>

1986	El Al Flight 016	Nezar Hindawi was found guilty of planning to bomb the plane by putting explosives in his fiancé's luggage.		0 Diplomatic dispute between West and Syria. Raised the issue of unwitting bomb carriers.
1986	Air Lanka Flight 512 ³⁶	A bomb exploded during loading	Sri Lankan civil war	14 killed
1986	Iraqi Airways Flight 163 ³⁷	Hijackers exploded grenades during the flight. Hezbollah claimed responsibility.	Terrorism; Middle East tensions	63 killed
1986	China Airlines 334	Pilot hijacked a freight plane from Taiwan to Thailand and took it to communist China. Possibly politically driven (defection to communist China) or to reunite with father in Sichuan (Nori, 2020, p. 65)	Cold War ideologies/family reunion.	0 killed. China returned the plane to Taiwan. This was the first meeting of Taiwanese and Chinese officials since 1949, and contributed to a thaw in relations. ³⁸
1986	Pan Am flight 73 hijacked	Hijackers boarded the plane disguised as security guards. ³⁹	Possibly seeking the release of political prisoners in Cyprus ⁴⁰	20 killed
1986	Sudan Airways flight hit by a missile	Surface-to-air missile fired by the Sudan People's Liberation Army.	Sudanese civil war	60 killed
1987	Downing of PSA Flight 1771,	A disgruntled ex-employee killed his former supervisor, flight crew, and himself,	Personal/employment.	43 killed US law changes to ensure that airline

³⁵ http://news.bbc.co.uk/onthisday/hi/dates/stories/april/2/newsid_4357000/4357159.stm

³⁶ <https://aviation-safety.net/database/record.php?id=19860503-1>

³⁷ <https://aviation-safety.net/database/record.php?id=19861225-1>

³⁸ <https://www.nytimes.com/1986/05/24/world/china-returns-hijacked-jet-and-2-crewmen-to-taiwan.html>

³⁹ http://news.bbc.co.uk/onthisday/hi/dates/stories/september/5/newsid_4576000/4576765.stm

⁴⁰ <https://aviation-safety.net/database/record.php?id=19860905-0>

		causing the plane to crash and killing 54. He had used his staff pass to bypass security (Nori, 2020; Price & Forrest, 2016).		employees hand in security passes as soon as they leave employment. Many large companies began to insist that their executives travelled on separate flights, after several lost more than one senior manager in this flight. ⁴¹
1987	Bakhtar Afghan Airlines Antonov An-26 ⁴²	Ground-to-air missile	War in Afghanistan	53 dead
1987	Zimex Aviation Lockheed L-100, Angola ⁴³	A Red Cross plane was hit by a missile, which may have been fired by a conflict party ⁴⁴	Angolan civil war	6 killed
1987	Air Malawi 7Q-YMB ⁴⁵	A domestic flight in Malawi was shot down over Mozambique	Mozambique civil war	10 killed
1987	Korean Air Flight 858 was destroyed in mid-air ⁴⁶	C-4 explosives placed by two North Koreans.	Conflict between North and South Korea	115 killed. Continued tensions. North Korea placed on the US list of state sponsors of terrorism.
1988	Iran Air Flight 655 hit by missile ⁴⁷	Missiles fired by the US Navy when misidentified as a military threat, possibly due to tensions	Iran-Iraq war.	290 killed Increased US-Iran

⁴¹ <https://slate.com/news-and-politics/2010/04/poland-s-leading-political-figures-died-in-a-plane-crash-over-the-weekend-could-that-happen-here.html>

⁴² <https://aviation-safety.net/database/record.php?id=19870611-0>

⁴³ <https://aviation-safety.net/database/record.php?id=19871014-0>

⁴⁴ <https://apnews.com/article/a79c31b3580287c8e13df7b00bf87cf2>

⁴⁵ <https://aviation-safety.net/database/record.php?id=19871106-1>

⁴⁶ <https://aviation-safety.net/database/record.php?id=19871129-0>

⁴⁷ <https://aviation-safety.net/database/record.php?id=19880703-0>

		around the war, software flaws and radio communication failures.		tensions. US paid compensation but did not acknowledge fault.
1988	Ariana Afghan Airlines shot down ⁴⁸	Shot down by the Pakistani military after entering Pakistani airspace due to a mechanical fault.		30
1988	T&G Aviation DC-7 hit by missile ⁴⁹	Two planes carrying American aid workers were shot with surface-to-air missiles by Western Saharan guerrilla fighters who mistook the planes for military aircraft.	Morocco-Western Sahara war	5
1988	Pan AM flight 103 was destroyed over Lockerbie ⁵⁰	The Libyan national Abdel Basset Ali al-Megrahi was convicted of carrying on an improvised explosive device. Libya accepted responsibility in 2002.	US-Libya tensions.	270 killed (244 passengers, 15 crew, and 11 on the ground below the explosion). The US and Scottish investigations found security lapses in baggage checking and explosive detection. Some limited changes implemented immediately (Price & Forrest, 2016, pp. 73–75). UK regulations on airports found to be weak (Price & Forrest, 2016, p. 73) UNSC demands Libya participate in investigation and sanctions placed on Libya [UNSC 748, 1992]

⁴⁸ <https://aviation-safety.net/database/record.php?id=19881119-0>

⁴⁹ <https://aviation-safety.net/database/record.php?id=19881208-1>

⁵⁰ <https://aviation-safety.net/database/record.php?id=19881221-0>

				FAA demanded airlines implement positive passenger bag match procedures (Klenka, 2019). ⁵¹
1988	Aeroflot flight 3729 hijacked ⁵²	A family of 11 hijacked the plane and asked to be flown to London. When refuelling in Leningrad, Soviet troops stormed the plane.	Soviet policies/asylum.	9 killed
1989	UTA Flight 772 was destroyed by a bomb ⁵³	Six Libyans were convicted	Chad-Libyan war	170 killed
1989	Avianca Flight 203 ⁵⁴	An improvised explosive device placed by a member of the Medellin drug cartel caused the plane to break up, possibly to kill informers.	Conflict between the Medellin drug cartel, the Colombian state and the US.	107 killed US action against Pablo Escobar, leader of the Medellin cartel.
1990	Xiamen Airlines 8301 hijacked ⁵⁵	A man hijacked a Chinese domestic flight and asked to be taken to Taiwan so he could request asylum. He had also stolen money from his company (Nori, 2020, p. 67)	Political conditions in China; personal reasons.	84 killed on the plane and 47 killed on a plane it hit when the hijacker took control.
1993	Transair Georgia and Orbia Georgian airways planes shot down	Shot by a surface-to-air missile by Abkhazian separatists	War in Abkhazia.	136 killed
1994	Rwandan government plane shot down ⁵⁶	Surface-to-air missiles fired by elements seeking to disrupt power sharing between Hutus and Tutsis	Hutu-Tutsi tensions in the Great Lakes region.	12 killed, including Rwandan and Burundian presidents. A trigger for conflict and genocide.

⁵¹ <https://www.propublica.org/article/20-years-after-lockerbie-aviation-security-gaps-remain-1222>;
<https://www.nytimes.com/2001/01/31/world/long-before-verdict-lockerbie-changed-airport-security.html#:~:text=The%20system%20does%20not%20require,sniffer%20machines%20or%20other%20means.>

⁵² <https://aviation-safety.net/database/record.php?id=19880308-0>

⁵³ <https://aviation-safety.net/database/record.php?id=19890919-1>

⁵⁴ <https://aviation-safety.net/database/record.php?id=19891127-0>

⁵⁵ <https://aviation-safety.net/database/record.php?id=19901002-3>

⁵⁶ <https://aviation-safety.net/database/record.php?id=19940406-1>

1994	Philippine Airlines Flight 434 was hit by an improvised explosive device. ⁵⁷	Ramzi Yousef, an Islamic terrorist, assembled the bomb in the plane toilet before leaving it under a seat and got off the plane. The bomb killed one passenger.	Islamic terrorism	1 killed. Yousef was also part of the unsuccessful 'Bojinka plot' to assassinate the Pope and destroy 11 passenger planes. Increased security in US airports - a 300-foot zone around airport terminals and air traffic control facilities where vehicles were not allowed to park. Airports lost revenue from parking (Klenka, 2019, p. 47).
1994	FedEx flight 1994 hijacked	An employee brought a spear gun, hunting knife and two hammers on board, in the hope of his family getting a life insurance pay out. Overpowered by crew (Nori, 2020, p. 69)	Personal factors (the hijacker was likely to lose his job after lying about his flying experience)	0 killed
1994	Royal Air Maroc flight 630 crashed by pilot	Crashed by pilot for personal motives (Nori, 2020, p. 69)	Personal motives	44 killed
1995	Kish Air flight 707 hijacked by a crew member	Desire to apply for asylum in Europe (Nori, 2020, p. 70).	Repression in Iran	0 killed
1996	TWA flight 800 crashed off New York	Accident, although feared to be a bomb or missile at the time.		230 killed The 'Gore Commission' on aircraft safety made recommendations to improve aviation security
1996	Ethiopian Airlines 961 hijacked	Three Ethiopians aimed to claim asylum in Australia. After ignoring the pilot's pleas to land and refuel, the plane ran out of fuel and crashed. The refusals to refuel suggest the hijackers wanted to crash the plane, or were too intoxicated to understand. The plane	Possibly seeking asylum	125

⁵⁷ <https://aviation-safety.net/database/record.php?id=19941211-5>

		crash-landed and some passengers survived. ⁵⁸		
1997	Silk Air flight 185 crashed by the pilot	Suicide (Nori, 2020, p. 72).	Personal reasons	104 killed
1998	Lionair Flight 602 ⁵⁹	Internal Sri Lankan flight shot down.	Sri Lankan civil war. Possibly shot down by Liberation Tigers of Tamil Eelam (LTTE)	55 killed
1998	Lignes Aeriennes Congolaises shot down ⁶⁰	Surface-to-air missile (SA7)	Civil war	41 killed
1999	Air Botswana aeroplane crashed by pilot	Pilot flew an empty plane until it ran out of fuel and crashed. Personal and professional reasons (Nori, 2020, p. 73).	Personal reasons	1 killed
1999	Egypt Air flight 990 crashed by co-pilot	Personal reasons	Insecurity in Egyptian pilot profession as a possible contributing factor (Nori, 2020, p. 77).	217 killed
2001	Siberian Airlines flight 1812 from Israel to Russia was shot down by Ukrainian defence force S-200V missiles ⁶¹	Shot by Ukrainian defence force S-200V missiles by accident,	Military manoeuvres.	78 killed.
2001	Cessna A185E shot down by Peruvian Air Force aided by CIA.	The CIA misidentified the plane as a potential target.	War on Drugs	2 killed. CIA amended practices
2001	Attacks on the US World Trade Center and Pentagon	Al-Qaeda members hijacked 4 planes, crashing 2 into the World Trade Center in New York, one into the Pentagon, and one crashed into a field as the hijacker was overpowered.	Islamic extremism	2,996 killed Increased security at airports around the world. Increased security on board including armoured flight deck doors. Most hijackings since then have been thwarted (Price & Forrest, 2016, p. 88)

⁵⁸ <https://aviation-safety.net/database/record.php?id=19961123-0>

⁵⁹ <https://aviation-safety.net/database/record.php?id=19980929-0>

⁶⁰ <https://aviation-safety.net/database/record.php?id=19981010-0>

⁶¹ <https://aviation-safety.net/database/record.php?id=20011004-0>

				<p>Direct economic effects worth USD 190 billion (Price and Forrest, 2016, p. 4).</p> <p>A 'war on terror' comprising enhanced measures against terrorist groups, war in Afghanistan, Iraq and a more aggressive US foreign policy, and increased counter-terrorism laws across the world.</p>
2001	Attempted bombings of American Airlines flight 63 from Paris to Boston ⁶²	Islamic extremist Richard Reid attempted to explode an improvised bomb hidden in his shoe, but was overpowered.	Islamic terrorism against the West	<p>0 killed.</p> <p>Increased security.</p> <p>Change is al-Qaeda approach from focusing on maximising violence to 'signalling' attacks which increase all costs to the West (Hastings & Chan, 2013).</p>
2002	Arkia flight 2002 from Kenya to Israel narrowly missed by missiles ⁶³	<p>Missiles fired by al-Qaeda operative.</p> <p>Happened on the same day as attacks on Israeli-owned businesses in Mombassa.</p>	Al-Qaeda terrorism	<p>0 killed</p> <p>EI Al Airline fleet given antimissile flare defence systems.</p> <p>Significant decline in tourism in Kenya because of airline and other attacks, although recovered within 6 months (Ashkenazi, 2013, p. 24)</p>
2002	China Northern Flight 6136 ⁶⁴	A fire caused the plane to crash. Believed to be caused by a man who had bought multiple life insurance policies and brought gasoline on board.	Personal reasons	112 killed

⁶² <https://aviation-safety.net/database/record.php?id=20011222-0>

⁶³ <https://aviation-safety.net/database/record.php?id=20021128-1>

⁶⁴ <https://aviation-safety.net/database/record.php?id=20020507-1>

2002	New Orleans shooting ⁶⁵	A man killed two people in the airport terminal before being overpowered	Unknown personal motivations.	2 killed Calls for more armed guards in airports.
2004	Siberia Airlines 1047 and Volga-Aviaexpress Flight 1303 ⁶⁶	Explosive devices went off on the two planes on the same day. A ticket agent was found to have taken a bribe to allow the bomber to board within ID. The bombers were assessed by a police officer who found no bombs and was later imprisoned for negligence (Price & Forrest, 2016, p. 90)	Chechen separatists claimed responsibility. Chechen-Russian conflict.	44 and 46 killed. Increased passenger security at Russian airports (inc. more searches and body imaging devices).
2006	Failed al-Qaeda plot ⁶⁷	Intelligence services foiled a plot to destroy airliners headed to the US using liquid explosives.	Al-Qaeda terrorism	Temporary cessation of UK air traffic 21 arrested Prohibition of liquids in cabin
2007	Vehicle-borne explosive driven into Glasgow Airport	Bollards in front of the building were effective (Price & Forrest, 2016, p. 89)	Terrorism	1 killed.
2009	Northwest Airlines Flight 253 ⁶⁸	A Nigerian national attempted to set-off an explosive device. Nicknamed the 'underwear bomber'	Islamic terrorism	0 killed. More security searches.
2010	Failed trans Atlantic plot ⁶⁹	Bombs found in passenger plane cargo holds between Yemen and the US, hidden in printers.	Islamic terrorism	Toner cartridges banned from passenger planes ⁷⁰

⁶⁵ <https://www.wlox.com/story/793093/airport-shooting-in-new-orleans-injures-two/>

⁶⁶ <https://aviation-safety.net/database/record.php?id=20040824-0>

⁶⁷ https://en.wikipedia.org/wiki/2006_transatlantic_aircraft_plot

⁶⁸ <https://aviation-safety.net/database/record.php?id=20091225-0>

⁶⁹ https://en.wikipedia.org/wiki/2010_transatlantic_aircraft_bomb_plot

⁷⁰ <https://www.france24.com/en/20101101-global-air-security-yemen-bomb-attack-usa-britain-terrorism-cargo>

2011	Bombing in airport terminals in Moscow ⁷¹	Suicide bombing	Islamic extremism or Caucasian nationalism.	35 killed
2013	Mozambique Airlines flight 470 crashed by pilot	Deliberately crashed by the pilot (Nori, 2020, p. 79).	Personal reasons	33 killed
2013	Shootings at Los Angeles International Airport ⁷²	The shooter was wounded by airport police (Price and Forrest, 2016, p. 90).		1 killed
2014	Malaysia Airlines flight MH17 shot down ⁷³	Shot down with a Russian-made Buk missile belonging to a Russian brigade in territory controlled by Russian-backed Ukrainian separatists ⁷⁴	Russian invasion of Ukraine.	298 killed The Netherlands and Australia have pointed to Russian responsibility and a Dutch court will try 4 Russian citizens in absentia. Increased tensions between Russia and the West. Calls for more caution from airlines flying over conflict zones (which are not always closed to air traffic by conflict parties).
2014	Malaysia Airlines flight 370 disappeared	Yet to be found	Second major disaster for Malaysia Airlines in a year.	239 missing Contributed to Malaysia Airlines' struggles and near bankruptcy, before it was taken over by a

⁷¹ <https://www.theguardian.com/world/2011/jan/24/domodedovo-airport-bombing-moscow>

⁷² https://en.wikipedia.org/wiki/2013_Los_Angeles_International_Airport_shooting

⁷³ <https://www.bbc.co.uk/news/world-europe-28357880>

⁷⁴ <https://www.onderzoekraad.nl/en/page/3546/crash-mh17-17-july-2014>

				sovereign wealth fund. ⁷⁵
2014	Ethiopian Airlines flight 702 hijacked ⁷⁶	Co-pilot hijacked the plane as part of a request for asylum	Personal/political reasons.	0 killed
2015	Germanwings flight 9525	Suicide of pilot	Mental illness. Self-reporting of symptoms and a fear of losing his licence without sufficient insurance means the mental illness of the pilot was not known. ⁷⁷	150 killed Changes to Lufthansa policy, and various countries' national laws, stipulating that two pilots need to be in the cockpit at any one time. Calls for more psychological testing of pilots. ⁷⁸
2015	Metrojet flight 9268 from Egypt ⁷⁹	Terrorism - improvised explosive device. Bombers aided by airport workers (<i>Trends in Aviation Terrorism</i> , 2016)	Islamic State terrorism	224 people killed. Cessation of passenger flights by many countries ⁸⁰ Tourism in Egypt significantly reduced.
2015	New Orleans machete attack ⁸¹ (Price and Forrest, 2016, p. 50).	A man attacked the airport with a machete before being shot. He also had Molotov	Unknown motive	Attacker shot and killed.

⁷⁵ <https://www.theguardian.com/business/2015/jun/01/malaysia-airlines-technically-bankrupt-christoph-mueller-cuts-boss>

⁷⁶ <https://www.bbc.co.uk/news/world-europe-26222674>

⁷⁷ <https://aviation-safety.net/database/record.php?id=20150324-0>

⁷⁸ <https://ec.europa.eu/transport/sites/transport/files/modes/air/news/doc/2015-07-17-germanwings-report/germanwings-task-force-final-report.pdf>

⁷⁹ <https://aviation-safety.net/database/record.php?id=20151031-0>

⁸⁰ <https://ospreyflightsolutions.exposure.co/45bfc62ef9dad7c5df70ba594625c83a>

⁸¹ https://www.nola.com/news/crime_police/article_8fb8a5ab-8a3c-5d19-b5ad-2dfaf515676f.html

		cocktails.		
2016	Dallo airlines D3 159 ⁸²	An explosive device blew a hole in the fuselage and a passenger fell out and died. Possibly aided by a airport worker (BaMaung et al, 2018)	Islamic terrorism; al-Shabaab conflict with government of Somalia.	1 killed.
2016	Attack at Brussels Airport ⁸³	Suicide bombers	Attacks claimed by Islamic State terrorist group	35 deaths
2016	Attack at Atatürk Airport in Istanbul	Shooting and suicide bombers	Turkey has blamed the Islamic State terrorist group, although the group has not claimed responsibility. The attackers were from the Caucasus ⁸⁴	48 killed Reduction in tourism to Turkey
2018	Possible drone attacks on UAE airports ⁸⁵	Yemen's Houthis claimed responsibility although the UAE denies this, as do other sources ⁸⁶	War in Yemen	Possible delays to flights. Houthi propaganda.
2018	Gatwick airport closed by a drone ⁸⁷	A drone was spotted near the airport, although the reason for flying it was not	Increased drone ownership among the general public.	Airport closure for several days. Increased attention to

⁸² <https://aviation-safety.net/database/record.php?id=20160202-0>

⁸³ <https://www.bbc.co.uk/news/world-europe-39350005>

⁸⁴ <https://www.bbc.co.uk/news/world-europe-36670576>

⁸⁵ <https://www.bellingcat.com/news/mena/2018/11/07/investigating-houthi-claims-drone-attacks-uae-airports/>

⁸⁶ <https://www.bellingcat.com/news/mena/2018/11/07/investigating-houthi-claims-drone-attacks-uae-airports/>

⁸⁷ <https://www.theguardian.com/uk-news/2020/dec/01/the-mystery-of-the-gatwick-drone>

		discovered by police.		the threat of drones. Gatwick and Heathrow spent £5 million on drone defences. UK legislation on drone ownership and use ⁸⁸
2019	Hijacking of Bangladesh Airlines flight 147	The hijacker used a toy gun and a fake explosive device.	Increased security incidents at Dhaka airport ⁸⁹	1 killed (suspect) Revisions to security
2020	African Express Airways plane shot down in Somalia ⁹⁰	Shot with a ZU-23 anti-aircraft cannon. Possibly by Ethiopian AMISOM troops although full facts unknown ⁹¹	Conflict in Somalia ⁹²	6 killed.
2020	Shooting down of Ukraine International Airlines flight PS752 ⁹³	Shot down by Iranian missiles by mistake ⁹⁴	Heightened tensions following killing of Iranian General Soleimani. The plane was flying close to a military centre.	176 people killed

Source: compiled by author from multiple sources.

⁸⁸ <https://www.gov.uk/government/news/new-powers-for-the-police-to-enforce-drone-laws>

⁸⁹ <https://ospreyflightsolutions.exposure.co/case-study-the-attempted-hijacking-of-a-biman-airlines-flight-from-dhakas-hazrat-shahjalal-international-airport-24th-february-2019>

⁹⁰ <https://aviation-safety.net/database/record.php?id=20200504-0>

⁹¹ <https://aviation-safety.net/database/record.php?id=20200504-0>

⁹² <https://www.bbc.co.uk/news/world-africa-52545582>

⁹³ <https://www.bbc.co.uk/news/world-middle-east-51073621>

⁹⁴ https://reports.aviation-safety.net/2020/20200108-0_B738_UR-PSR_FACTUAL.pdf

3. Factors shaping threats

Types of threat

This section discusses the different trends in malicious incidents. It discusses both the motivations behind attacks and the means of attacks as threats (or underlying factors shaping threats). It also discusses aviation security measures as shaping the opportunities available to malicious actors.

Underlying many of these threats is the fact that civilian aviation is a high-profile target for terrorists and others. Attacking **civilian aviation is attractive to terrorists because**: any act is likely to be visible across the globe, can be highly lethal and affect citizens of several countries, is likely to 'depreciate the embodiment of state power that airlines and airports symbolise', make a powerful statement to world leaders, have significant direct and indirect economic consequences, and impede global connectivity. **For criminals**, civilian aviation provides a means to transport illicit goods or money (Price & Forrest, 2016). It also provides a high-profile target for those seeking ransoms. **For individuals fleeing persecution or poverty**, aviation offers the potential of transcending state boundaries (Scott, 2019).

Threats must be seen in the context of the security measures in place to prevent them. Criminologists show how the effect of measures to prevent attacks on potential future attackers varies depending on the aims of the attackers. Some scholars speak of a 'contagion effect' as successful hijackings encourage others, while increased security measures act as a deterrent (Dugan et al., 2005). However, other scholars have found that, in the case of al-Qaeda terrorism, 'hardening' a target (i.e. greater security) does not reduce its attractiveness as terrorists aim to maximise the 'symbolic value' of their attacks, i.e. not just the death toll but the costs of increased vigilance imposed on the target states (Hastings & Chan, 2013).

Attackers and security planners have adapted over the years (Price & Forrest, 2016, pp. 60–61). Attacks usually lead to changes in security practices. Over the years, security has increased and measures are usually put in place following a high-profile incident. Complacency, the desire of airport and airline operators to maximise profits, the global nature of air travel, and the evolving tactics of attackers are barriers to effective safety measures. Forrest and Price (2016) show how increased passenger searches in the 1970s did not protect against fake or non-existent bombs. Similarly, the metal detectors and x-ray machines widely installed since the 1970s do not detect semtex, used in the Lockerbie bombing, or liquid explosives. Authorities do not always anticipate changes, or implement changes in a timely manner after failed attacks (Price and Forrest, 2016, p. 91). Increased security on planes has possibly led to more attacks on airports. It is unclear how protected the aviation system is from cyber attacks.

Trends

Between 1930 and 1979, there were a number of hijackings by individuals escaping persecution. For instance, there were a number of Cubans fleeing Cuba, or leftists fleeing America to Cuba, in the period and beyond (Klenka, 2019, p. 42). By the 1960s, terrorist groups began to use hijackings to bargain and gain attention. The implementation of passenger and baggage screening with the US Anti-Hijacking Act in 1974 led to a decrease of hijackings and bombings, particularly in the US (Price & Forrest, 2016, p. 46). In the mid-1970s, measures against hijacking became stronger in a number of states, including armed guards on US planes and tactical units within German and Soviet security forces (Scott, 2019, p. 240). Measures to prevent

hijackings by asylum seekers were also put in place, including an extradition treaty between Cuba and the US in the early 1970s (Price & Forrest, 2016, p. 48). It is estimated that 41% of hijackings and 24% of bombings were foiled in the period 1977-1986, a significant increase on the previous decade, although the success rate fell significantly afterwards (Merari, 1998, p. 21).

Between 1980 and 1990. There were fewer incidents in the US, but US-flagged airlines overseas were attacked. Some of the deadliest attacks occurred, including Pan Am flight 103 and Air India flight 182. Price and Forest (2016, p. 47) argue that these two events led the airline industry to focus on the threat of bombings and neglect hijacking until the 2001 attacks on the US. Between 1990 and 2001, attacks on aviation decreased significantly (Price & Forrest, 2016, p. 61). The 2001 attacks on the US prompted significant increases in aviation security, including armoured cabin doors, although aeroplanes and airports remained important targets for terrorist groups. Other threats, such as suicidal aircrew, or missiles in conflict zones, remained.

Duchesneau and Langlois (2017) compiled a database of 'acts of unlawful interference' on civil aviation from 1931 to 2016. They categorised attacks as ground attack, hijacking, sabotage and suicide mission. In total, they found 2,071 acts of unlawful interference (635 of which are 'definitively' terrorist) causing 9,508 deaths. They divide the acts into:

- Ground attack 536 (1,865 deaths);
- Hijacking 1,308 (814 deaths);
- Sabotage 174 (2,829 deaths),
- Suicide mission 53 (4,000 deaths)

There have been definite falls in incidents relative to the number of civilian flights over the decades. The risk of civilian air travel has declined in the period surveyed: 'since 1970 the fatal accident rate for U.S. airlines has dropped over 90% while traffic in the air has soared' (McCrie & Haas, 2018). In addition, 'statistics point to a decrease in the number of terrorist attacks since 2003, while air traffic has grown at about 5 per cent annually during the same period' (Duchesneau & Langlois, 2017, p. 351). Nevertheless, a single attack can have a significant effect. Moreover, the levels of risk and safety are uneven, with some areas of the world facing higher risk, as well as emerging threats. An attack can dent a country's tourism income in the short-term.

There is a negative correlation between the method of attack and the number of people killed. Of the four methods surveyed by Duchesne and Langlois (2017) - ground attack, hijacking, sabotage, suicide mission - the most frequently used (hijacking, 1,308 incidents) has killed the fewest people (814); whereas the least common (suicide, 53 incidents), has produced the most deaths (see also Price and Forrest, 2016, p. 49). This may be explained by a number of factors, including that hijackers often intend to use civilians as leverage rather than killing them as an end, and the large number killed in the suicide attacks on the World Trade Centre in September 2001.

Terrorism

A significant number of hijackings and bombings since the 1960s can be attributed to what may broadly be termed terrorist groups.⁹⁵ These attacks have a variety of motives and aims. Some of the most prevalent are:

- Calling for the release of political prisoners.
- Using the hostages to demand a ransom or something else from authorities.
- The airing of grievances.
- Attacking passengers or airlines linked to a particular nationality or religion (e.g. Israel or Jews).
- The destruction of sites of symbolic importance (e.g. the World Trade Center, or an aeroplane).

In the 1960s and 1970s, Palestinian groups were prominent, partly because the global, trans-border nature of air travel allowed them to effectively highlight the plight of stateless Palestinians through hijacking (Scott, 2019, p. 224). The increasing hardening of attitudes against hijacking saw the Palestinian Liberation Organisation turn away from the method, but other groups such as the Abu Nidal organisation continued to use it. The development of anti-terrorism units within national police, as well as policies such as Israel's of accompanying taxiing aircraft with armed vehicles, reduced the threat of hijackers. Anti-hijacking tactics developed, such as seeking to stay on the ground, or for aircrew to escape so that the plane could not be flown. States became less willing to negotiate. All of these changes meant hijacking was less likely to be successful.

The use of bombs and suicide bombers presents a different threat to hijackers, as the former often do not aim to negotiate. Islamic terrorist organisations have sought to bomb and crash civilian aeroplanes and states have attacked planes such as North Korea's 1987 attack on Korean Air Flight 858, and the 1988 Lockerbie bombing by Libya. Despite increased security and awareness, high profile incidents such as the bombing of Air India 181 or the Lockerbie bomb, and the 9/11 attacks, highlighted flaws and lapses in security procedures. Terrorists have increased attacks on airports, and shown interest in technologies such as drones (*Trends in Aviation Terrorism*, 2016). 'Lone wolf' terrorists, without the resources of an organised group, may focus on attacking an airport terminal with a gun or knife (Feldman, 2020, p. 52). However, significant attacks on airports also occurred in previous decades such as those on Rome and Vienna airports in 1985.

Individual

A number of security incidents can be attributed to individuals with what may be termed personal motivations or drivers for deliberately attacking planes. This includes committing suicide by crashing a plane or attacking other members of staff (Nori, 2020; Price & Forrest, 2016, pp. 82–83).

A second individual factor is airport or airline staff who accept bribes or allow security threats to pass through security (*Trends in Aviation Terrorism*, 2016). Staff often bypass security checks and are therefore a significant risk (BaMaung et al., 2018). For example, the

⁹⁵ Some, but not all, of these groups may be designated terrorist groups by particular states.

attacks on Siberian Airlines flights in 2004 were facilitated by the bribing of a member of airport staff.

Although the reasons behind each person's actions are unique, ranging from marital problems to grievances against their employer and mental illness, there are a number of broad factors used to explain such incidents. These drivers include combinations of mental illness, financial motives, pride, etc. The literature points to a number of potential factors shaping this threat:

- Airline screening procedures and psychological support.
- National airline cultures, remuneration and employment rights. This is sometimes pointed to as a reason why a pilot suffering from mental illness does not declare it. If they are likely to lose their licence to fly or financial security through a lack of social safety nets, they are more likely not to declare a problem. The role of honour and shame may also be a contributing factor (*Trends in Aviation Terrorism*, 2016).
- The working conditions of airline pilots, particularly lack of sleep, are shown to have a possible effect on levels of depression. However, the links are weak (Pasha & Stokes, 2018).

Examples include the pilot-induced crashes of Japan Airlines flight 350 in 1982 or Egypt Air flight 990 in 1999 likely due to fears about job security; the likely ideologically driven hijacking of (Taiwanese) China Airlines 334 freight plane in 1986 to go to the People's Republic of China; and the Germanwings crash of 2015.

Asylum

A number of individuals have hijacked planes as a way to seek asylum in another country.

This was particularly the case for individuals living in states restricting exit such as the USSR (Scott, 2019). Western publics and sometimes governments pushed for these individuals to be granted asylum, or were at least reluctant to send them back to the USSR. **However, by the 1970s, global laws and conventions against hijacking encouraged extradition and stronger measures from individual states determined to prevent hijackings**, like those undertaken by Palestinian groups, from disrupting air travel saw a hardening against this type of escape (Scott, 2019).

Examples include attempts by citizens of the Soviet Union or Warsaw Pact countries to seek asylum in the West and Cubans in America in the 1960s and 70s; Americans seeking asylum in Cuba; the hijacking of Aeroflot flight 3729 in 1988 by a family demanding to go to London; and the co-pilot's hijacking of Ethiopian Airlines flight 702 in 2014 in order to make an asylum claim. The hijacking of Xiamen Airlines flight 8301 in 1990 by a man wanting to claim asylum in Taiwan is another example.

Conflict

A number of security incidents have occurred near conflict zones. In some cases, a civilian aeroplane may be misidentified as a threat and hit with a missile. In others, a plane may be deliberately targeted. A number of civilian airliners were hit by missiles in the wars in Angola, Sudan and Ukraine, for instance. Since 1938, about 80 incidents featuring the shooting down of a commercial airliner have occurred (Klenka, 2019, p. 60). This includes attacks in conflict zones by state actors and non-stated armed groups (including terrorists) and by these actors outside of conflicts. There have been calls for planes to be routed away from conflict zones more

systematically. Currently the decision is made by states and airlines and is therefore not consistently applied.

The tensions surrounding wars can also increase the likelihood of an unintentional, fatal attack. During the Iran-Iraq war, the US, not a formal combatant, shot down Iran Air Flight 655, killing all of its passengers, after its battleship misidentified the airliner as a threat. Similarly, the recent shooting down of Ukraine International Airlines flight PS752 in 2020 by an Iranian missile shows the dangers created by tensions. The Iranians identified the plane as a threat as it passed near to a military facility, at a time of heightened tensions in Iran following the assassination of an Iranian general. The Soviet air force shot down Korean Air flight 902 in 1978 and Korean Air Lines 007 in 1983, after the airliners strayed into Soviet airspace. While navigation errors and a lack of GPS are a cause, the Cold War tensions also likely contributed. Recently, tensions between India and Pakistan have led to precautionary measures. In 2019, Pakistan closed most of its airspace (February to July) and the US, European, UK, German and French have issued warnings to civilian aeroplanes.⁹⁶

Rebel groups with less capacity to identify threats, less coherent command structures, or less chance of winning through conventional means, may be more likely to attack a civilian aircraft. This may be facilitated by increased supply of surface-to-air missiles during a conflict, for example (Ashkenazi, 2013, p. 16). The Polar 3 scientific plane was hit by a missile fired by Western Saharan separatists in 1985, after it was misidentified as a threat. Georgian civilian planes were hit by a missile fired by Abkhazian separatists in 1993. A recent report points to the possibility of rockets fired by the Tigray People's Liberation Front (TPLF) in Ethiopia hitting civilian aircraft or airports.⁹⁷ This threat is stronger in fragile or conflict-affected contexts and 'manpad' surface-to-air missiles have never been used in developed countries.

In some cases, civilian airliners are targeted deliberately as in Air Rhodesia flight 825 in 1978 and 827 in 1979, which were shot down by the Zimbabwe People's Revolutionary Army during conflict between colonial and anti-colonial forces, partly to target senior opposition figures. It is unclear how deliberate the shooting down of Malaysian Airlines flight MH17 by a missile belonging to a Russian brigade in Ukraine was, although the ongoing war and the Russian use of semi-independent fighting units may be contributing factors.

Civilian aircraft have been destroyed on the ground, usually without fatalities, during conflicts such as the Lebanese war, the Gulf War, the NATO war in Libya.

Organised crime

Organised crime can also create and expose weaknesses in aviation security that terrorists might exploit. According to one report, 'international drug trafficking through airports, which is often facilitated by corruption, is the structural basis on which terrorists might also consummate their deadly attacks.' It points to 'indifference' from South American aviation authorities, which allows the movement of illicit goods, and potential threats to aircraft (*Drug Trafficking and Terrorism*, 2017).

⁹⁶ <https://ospreyflightsolutions.exposure.co/indiapakistan-navigating-airspace-disruption-amid-heightened-tensions>

⁹⁷ <https://ospreyflightsolutions.exposure.co/analysis-tigray-conflict>

Several attacks on civilian planes can be directly linked to the illegal drug trade in South America. For instance, in 1989, the Medellin cartel destroyed Avianca Flight 203 in Colombia, possibly with the motive of killing an informant on the plane.

Cyber

Cyber attacks pose a significant threat to civilian aviation. A recent article notes that a number of computer systems used in aviation are hackable: reservation systems, flight traffic management systems, access control management systems, departure control systems, passport control systems, cloud-based airline data storage, hazardous materials transportation management, cargo handling and shipping (*Four Threats to Aviation Security – and Four Responses*, 2016; Ken-Dror & Gross, 2019). It also notes that aeroplanes will usually use flight control systems, GPS-based navigation systems, fuel gauges and fuel consumption systems, and maintenance computers, among others, that are hackable (*Four Threats to Aviation Security – and Four Responses*, 2016; Ken-Dror & Gross, 2019).

The threat is considerable because many people have the means to hack these systems (*Four Threats to Aviation Security – and Four Responses*, 2016). A hacker can remotely attack plane navigation systems and have taken control of planes' movements using relatively simple technology like laptops and smartphones (Ken-Dror & Gross, 2019, pp. 139–140).

A cyber attack may also be harder to detect if, for example, terrorists divert a plane without the pilots noticing. Malicious computer code can also be put onto an aeroplane or systems long before it is activated (Ken-Dror & Gross, 2019, p. 166)

The systems involved in civilian aviation, such as check-in or air traffic control, are also vulnerable. Airport systems may not be run by each airport, e.g. check-in systems operated multinationally, meaning that an attack on a big operator may affect several airports (Ken-Dror & Gross, 2019). There are several examples of cyber attacks affecting air operations, including:

- A 2006 cyber attack saw the FAA shut down air traffic control systems in Florida (Ken-Dror & Gross, 2019, p. 135) .
- In 2013, a cyber attack against Istanbul airport affected the passport control system and delayed flights (Ken-Dror & Gross, 2019, p.136).
- In 2017, Ukraine's Boryspil International Airport saw its computers and departure boards disabled by a cyber attack (Ken-Dror & Gross, 2019, p.136).
- 'On August 20, 2008, Spanair Flight 5022 (JK5022) from Barcelona's El Prat airport (via Madrid's Barajas airport) to Gran Canaria airport in Spain, crashed minutes after taking off from Madrid airport. One hundred and fifty-three people died, and 18 survived. Two years later, in a hardly circulated notice, Spanair reported that the company's main computer, which recorded aircraft malfunctions, had been contaminated with malicious computer programs and, therefore, might not have recognized the airplane's problems before take-off' (Ken-Dror & Gross, 2019, p. 137).
- 'In June 2015, the Polish airline LOT reported a cyber-attack that affected its ground operation systems, which prevented the LOT personnel from developing flight plans' (Ken-Dror & Gross, 2019, p. 138).

UAVs

Unmanned aerial vehicles are seen as a growing threat to civilian aviation. For terrorists, drones are 'lower risk and less costly than sending operatives aboard a commercial plane to disrupt its flight' (Chávez, 2020). UAVs are used widely by civilians including hobbyists, so not all incidents are straightforwardly 'malicious'.

UAVs have been responsible for a number of incidents in the US and UK, although it is not always clear what the intention of the UAV users was. Using internet searches and NASA and FAA databases, Pyrgies (2019) has identified 139 UAV incidents within 35 kilometres of civilian airports between May 2014 and May 2018. Incidents covered are: near mid-air collisions (NMAC), mid-air collisions (MAC), airspace closures, jetlining sightings and airport indoor sightings. It includes 13 incidents in UK airports, and 24 at US airports. Dubai airport had to close three times, London Gatwick twice, and Sharjah International, Chengdu Shuangliu International, Chongqing International and Auckland International all had to close once in the period. He notes that, 'in 137 cases out of 139, neither the pilot nor the UAV could be identified by the forensic investigation that has been systematically launched after the incident.' In the UK in 2018, there were around 15 'airprox' incidents - defined as incidents where drones come close enough to planes to possibly compromise safety - per month (Chavez, 2020, p. 37). There have been a number of near misses. For example, in 2014 an American Airlines Group regional jet in Florida nearly collided with a drone at 2,300 feet (Maddox & Stuckenberg, 2015).

Terrorists have planned to use drones against civilian aviation. Yemeni Houthi groups have reported attacking civilian airports in the UAE, although the UAE denies this.

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Key websites

- Aviation Safety Network: <https://aviation-safety.net>

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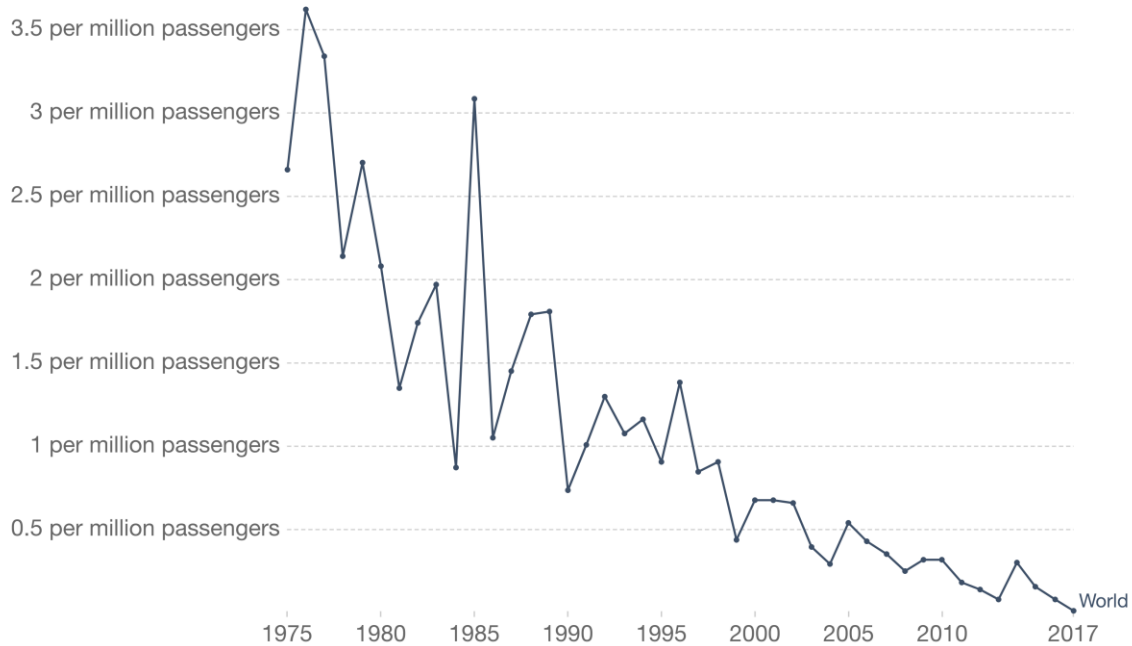
Appendix: Trends in airline fatalities and hijackings, 1975-2017

Fatalities from commercial airlines per million passengers, 1975-2017

Aviation fatalities from commercial airlines per million passengers, World, 1975 to 2017

Our World
in Data

Global number of fatalities from aviation accidents per million air passengers carried. Fatality figures are based on the number on commercial flights (with capacity for 14+ passengers) and do not include corporate jet or military transport incidents.



Source: Aviation Safety Network (ASN)

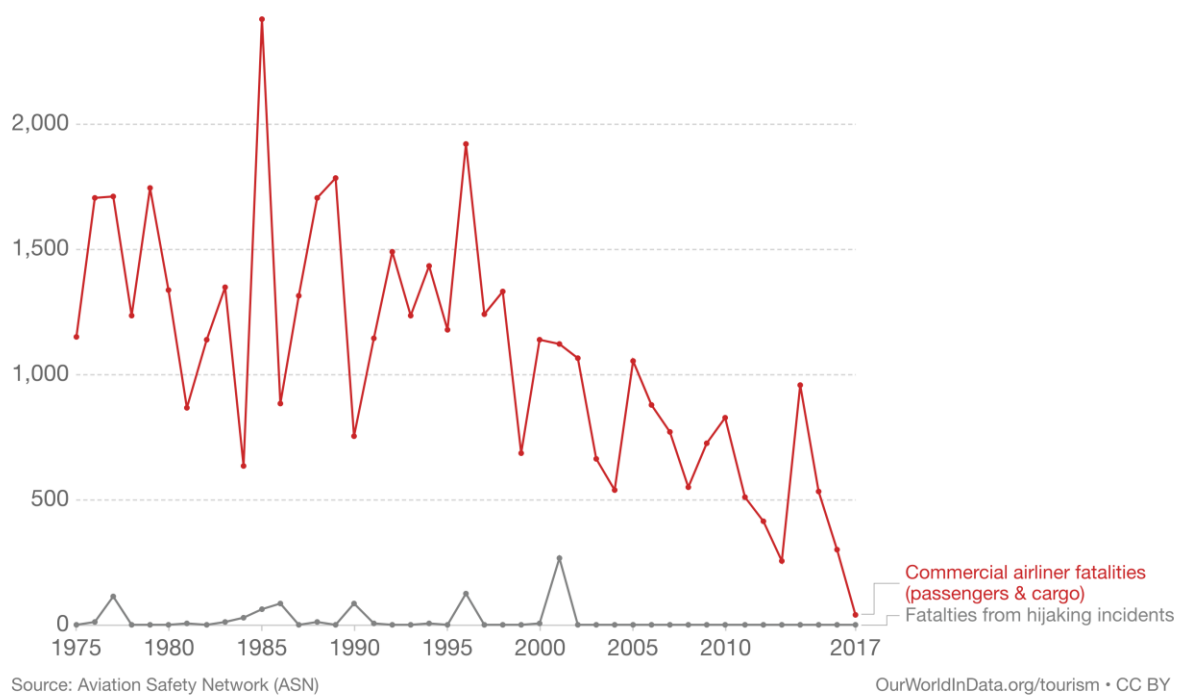
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Fatalities from aviation accidents and hijackings, global, 1975-2017⁹⁸

Global fatalities from aviation accidents and hijackings

Data is based on cargo and passenger commercial airliners (equipped with capacity for 14+ passengers) and does not include corporate jet and military transport incidents. The fatalities from hijackings are also included in total commercial airliner figures.



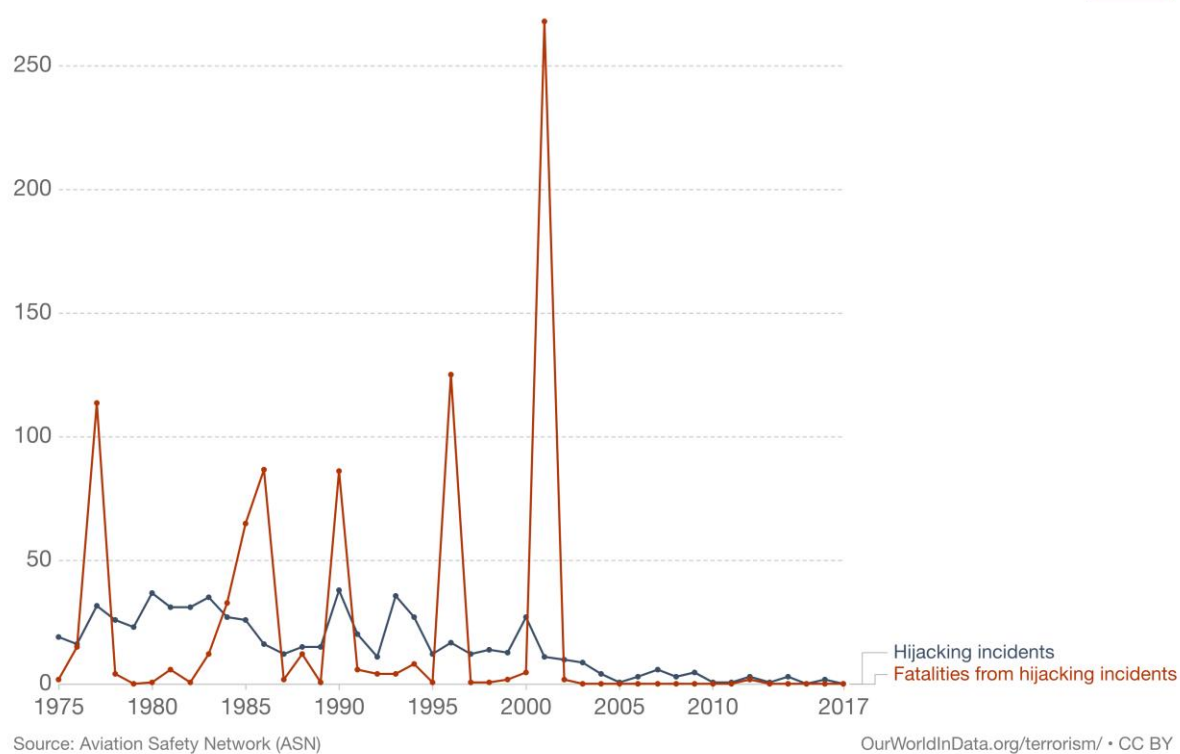
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⁹⁸ This graph includes fatalities from non-malicious accidents.

Number of airliner hijackings and fatalities, global, 1975-2017⁹⁹

Global number of airliner hijackings and fatalities

Our World
in Data



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⁹⁹ These figures may not tally with those in the table in figure 1, as the table includes bystanders killed by aircraft accidents (e.g. those killed in the World Trade Centre), whereas the graph appears only to include passengers.